CLAIMS

WHAT IS CLAIMED IS:

1. An earth boring bit comprising:

a) a bit body having a longitudinal bit axis and a bit diameter;

b) at least one rolling cone cutter rotatably mounted on the bit body and having an offset of its rotational axis from the bit axis of:

1) at least 1/8 inch when the bit diameter is less than 4 inches,

2) at least 5/32 inches when the bit diameter is 4 inches or greater and less than 5 inches,

3) at least ¼ inches when the bit diameter is 5 inches or greater and less than 7 inches,

4) at least 1/32 inches when the bit diameter is 7 inches or greater and less than 9 inches,

5) at least 13/32 inches when the bit diameter is 9 inches or greater and less than 12 inches,

6) at least 7/16 inches when the bit diameter is 12 inches or greater and less than 16 inches, and

7) at least 17/32 inches when the bit diameter is at least 16 inches; and

c) at least one super-abrasive cutter element located on the rolling cone cutter and extending to full gage diameter.

2. The bit of claim 1 wherein the amount of offset is:

a) at least 5/32 inches and less than 3/16 inches when the bit diameter is less than 4 inches,

b) at least 3/16 inches and less than ¼ inches when the bit diameter is at least 4 inches and less than 5 inches,

c) at least 9/32 inches and less than 5/16 inches when the bit diameter is at least 5 inches and less than 7 inches,

d) at least 3/8 inches and less than 7/16 inches when the bit diameter is at least 7 inches and less than 9 inches,

e) at least 15/32 inches and less than 9/16 inches when the bit diameter is at least 9 inches and less than 12 inches,

f) at least 19/32 inches and less than ¾ inches when the bit diameter is at least 12 inches and less than 16 inches, and

g) at least ¾ inches and less than 1 inch when the bit diameter is at least 16 inches.

3. The bit of claim 1 wherein the amount of offset is:

a) at least 3/16 inches when the bit diameter is less than 4 inches,

b) at least ¼ inches when the bit diameter is at least 4 inches and less than 5 inches,

c) at least 5/16 inches when the bit diameter is at least 5 inches and less than 7 inches,

d) at least 7/16 inches when the bit diameter is at least 7 inches and less than 9 inches,

e) at least 9/16 inches when the bit diameter is at least 9 inches and less than 12 inches,

f) at least ¾ inches when the bit diameter is at least 12 inches and less than 16 inches, and

g) at least 1 inch when the bit diameter is at least 16 inches.

4. The bit of claim 1 wherein the super-abrasive cutter element comprises a polycrystalline diamond coated insert.

5. The bit of claim 1 wherein the super-abrasive cutter element comprises a cubic boron nitride coated insert.

6. The bit of claim 1 wherein the super-abrasive cutter element is located on the gage row of the cone cutter.

7. The bit of claim 1 wherein the super-abrasive cutter element is located on a secondary gage row of the cone cutter.

8. The bit of claim 1 wherein the super-abrasive cutter element is located on a heel row of the cone cutter.

9. The bit of claim 1 wherein the cone cutter has a journal angle of about 33° or less.

10. The bit of claim 1 wherein the bit is a soft to medium-hard formation insert bit.

11. The bit of claim 10 wherein the bit has an IADC classification of 6-2-x or lower series ~~number~~.

12. The bit of claim 11 wherein the bit has an IADC classification of 4-4-x or lower series number.

13. The bit of claim 1 wherein the bit is a milled tooth bit.

14. The bit of claim 13 wherein the bit has an IADC classification of 2-3-x or lower series number.

15. The bit of claim 14 wherein the bit has a IADC classification of 1-3-x or lower series number.

16. The bit of claim 1 further comprising a super-abrasive cutter element located on an off-gage row of the cone cutter.

17. The bit of claim 1 further comprising a super-abrasive cutter element located on an inner row of the cone cutter.

18. The bit of claim 1 wherein there are three rolling cone cutters, each of which is offset.

19. The bit of claim 18 wherein each of the three cone cutters has substantially the same amount of offset.

20. The bit of claim 1 wherein there are super-abrasive cutter inserts located on both a gage row and a heel row of the rolling cone cutter.

21. An earth boring bit comprising:

a) a bit body having a longitudinal bit axis and a bit diameter;

b) at least one rolling cone cutter rotatably mounted on the bit body and having an offset of its rotational axis from the bit axis of:

1) at least 1/8 inch when the bit diameter is less than 4 inches,

2) at least 5/32 inches when the bit diameter is 4 inches or greater and less than 5 inches,

3) at least ¼ inches when the bit diameter is 5 inches or greater and less than 7 inches,

4) at least 11/32 inches when the bit diameter is 7 inches or greater and less than 9 inches,

5) at least 13/32 inches when the bit diameter is 9 inches or greater and less than 12 inches,

6) at least 7/16 inches when the bit diameter is 12 inches or greater and less than 16 inches, and

7) at least 17/32 inches when the bit diameter is at least 16 inches; and

c) at least one super-abrasive cutter element located on the cone cutter.

22. The bit of claim 21 wherein the amount of offset is:

a) at least 5/32 inches and less than 3/16 inches when the bit diameter is less than 4 inches,

b) at least 3/16 inches and less than ¼ inches when the bit diameter is at least 4 inches and less than 5 inches,

c) at least 9/32 inches and less than 5/16 inches when the bit diameter is at least 5 inches and less than 7 inches,

d) at least 3/8 inches and less than 7/16 inches when the bit diameter is at least 7 inches and less than 9 inches,

e) at least 15/32 inches and less than 9/16 inches when the bit diameter is at least 9 inches and less than 12 inches,

f) at least 19/32 inches and less than ¾ inches when the bit diameter is at least 12 inches and less than 16 inches, and

g) at least ¾ inches and less than 1 inch when the bit diameter is at least 16 inches.

23. The bit of claim 21 wherein the amount of offset is:

a) at least 3/16 inches when the bit diameter is less than 4 inches,

b) at least ¼ inches when the bit diameter is at least 4 inches and less than 5 inches,

c) at least 5/16 inches when the bit diameter is at least 5 inches and less than 7 inches,

d) at least 7/16 inches when the bit diameter is at least 7 inches and less than 9 inches,

e) at least 9/16 inches when the bit diameter is at least 9 inches and less than 12 inches,

f) at least ¾ inches when the bit diameter is at least 12 inches and less than 16 inches, and

g) at least 1 inch when the bit diameter is at least 16 inches.

24. The bit of claim 21 wherein the super-abrasive cutter element extends at least to near gage diameter.

25. The bit of claim 21 wherein the super-abrasive cutter element is located on an inner row of the rolling cone cutter.

26. The bit of claim 25 wherein the super-abrasive cutter element comprises a polycrystalline diamond coated insert.

27. The bit of claim 21 wherein the super-abrasive cutter element extends to substantially full gage diameter.

28. The bit of claim 22 wherein the super-abrasive cutter element comprises a polycrystalline diamond coated insert.

29. The bit of claim 23 wherein the super-abrasive cutter element comprises a polycrystalline diamond coated insert.

30. A hard to extremely hard formation-type earth boring bit having an IADC numeric nomenclature of 6-3-x or higher and comprising:

a) a bit body having a longitudinal bit axis and a bit diameter;

b) at least one rolling cone cutter rotatably mounted on the bit body and having an

offset of its rotational axis from the bit axis of:

1) at least 1/16 inches when the bit diameter is less than 7 inches,

2) at least 3/32 inches when the bit diameter is at least 7 inches and less than 12 inches,

3) at least 5/32 inches when the bit diameter is at least 12 inches; and

c) at least one super-abrasive cutter element located on the cone cutter.

31. The bit of claim 30 wherein the super-abrasive cutter element is located on an inner row of the rolling cone cutter.

32. The bit of claim 30 wherein the super-abrasive cutter element extends to at least near gage diameter.

33. The bit of claim 32 wherein the super-abrasive cutter element comprises a polycrystalline diamond coated insert.

34. The bit of claim 30 wherein the amount of offset is:

a) at least 3/32 inches and less than 1/8 inches when the bit diameter is less than 7 inches,

b) at least 5/32 inches and less than 7/32 inches when the bit diameter is at least 7 inches and less than 12 inches, and

c) at least 7/32 inches and less than 9/32 inches when the bit diameter is at least 12

inches.

35. The bit of claim 34 wherein the super-abrasive cutter element comprises a polycrystalline diamond coated insert.

36. The bit of claim 30 wherein the amount of offset is:

a) at least 1/8 inches when the bit diameter is less than 7 inches,

b) at least 7/32 inches when the bit diameter is at least 7 inches and less than 12 inches, and

c) at least 9/32 inches when the bit diameter is at least 12 inches.

37. The bit of claim 36 wherein the super-abrasive cutter element comprises a polycrystalline diamond coated insert.

38. The bit of claim 30 wherein the cone cutter has a journal angle of about 36° or more.

39. The bit of claim 32 wherein the super-abrasive cutter element is located on a gage row of the rolling cone cutter.

40. The bit of claim 32 wherein the super-abrasive cutter element is located on a secondary gage row of the rolling cone cutter.

41. The bit of claim 32 wherein the super-abrasive cutter element is located on a heel row of the rolling cone cutter.

42. The bit of claim 39 further comprising a super-abrasive cutter element located on the inner row of the rolling cone cutter.

43. The bit of claim 30 wherein the super-abrasive cutter element comprises a cubic boron ~~nitride coated insert.~~

44. A medium-hard to extremely hard formation-type earth boring bit comprising:

a) a bit body having a longitudinal bit axis and a bit diameter;

b) at least one rolling cone cutter rotatably mounted on the bit body and having an offset of its rotational axis from the bit axis of:

4) at least 1/16 inches when the bit diameter is less than 7 inches,

5) at least 3/32 inches when the bit diameter is at least 7 inches and less than 12 inches,

6) at least 5/32 inches when the bit diameter is at least 12 inches; and

c) a journal angle being formed between the rotational axis and the bit axis of at least 36°;

d) at least one super-abrasive cutter element located on an inner row of the cone cutter.

45. The bit of claim ~~44~~ wherein the super-abrasive cutter element comprises a polycrystalline

diamond coated insert.

~~46~~. The bit of claim ~~44~~ wherein the super-abrasive cutter element comprises a cubic boron nitride coated insert.

47. The bit of claim 44 wherein the amount of offset is:

a) at least 3/32 inches and less than 1/8 inches when the bit diameter is less than 7 inches,

b) at least 5/32 inches and less than 7/32 inches when the bit diameter is at least 7 inches and less than 12 inches, and

c) at least 7/32 inches and less than 9/32 inches when the bit diameter is at least 12 inches.

48. The bit of claim 44 wherein the amount of offset is:

a) at least 1/8 inches when the bit diameter is less than 7 inches,

b) at least 7/32 inches when the bit diameter is at least 7 inches and less than 12 inches, and

c) at least 9/32 inches when the bit diameter is at least 12 inches.

~~49~~. The bit of claim ~~44~~ wherein the bit comprises an insert bit having an IADC classification of 6-1-x or higher series number.

50. The bit of claim 44 further comprising a super-abrasive cutter element located on a gage row of the rolling cone cutter.

51. The bit of claim 44 further comprising a super-abrasive cutter element located on a secondary gage row of the rolling cone cutter.

52. The bit of claim 44 further comprising a super-abrasive cutter element located on a heel row of the rolling cone cutter.

53. The bit of claim 44 further comprising super-abrasive cutter elements located on all the inner rows of all the rolling cone cutters.